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(54) Encoded marking of a recording signal

(57) A marking signal 1 identifying the owner of a recording and formed by binary elements passes from a data store 2 to code generator 3, which translates each like binary element into a pseudo random sequence of binary elements, to produce an encoded marking signal and then, *via* low pass filter 4 and multiplier 5, passes to multiplier 6 with an audio signal 7 input to effect amplitude modulation thereof. After filtering by high pass filter 8, the signal is added to the audio signal channel by circuit 9. Decoder 11 (also Fig. 3) enables extraction of the marking signal for identification. The arrangement facilitates proof of ownership of illegal re-recordings and automatic logging of playback time for royalty purposes.

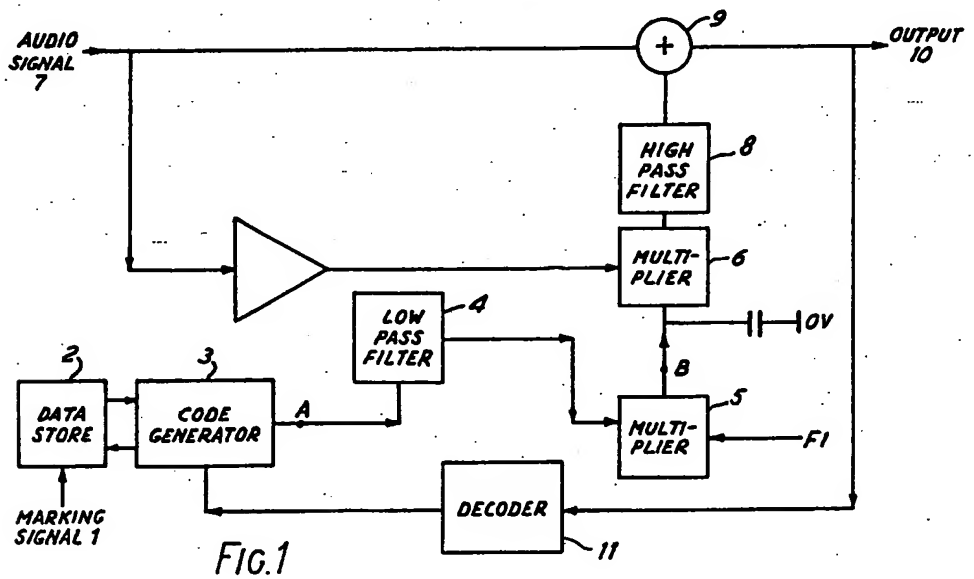


FIG.1

GB 2 196 167 A

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

2196167

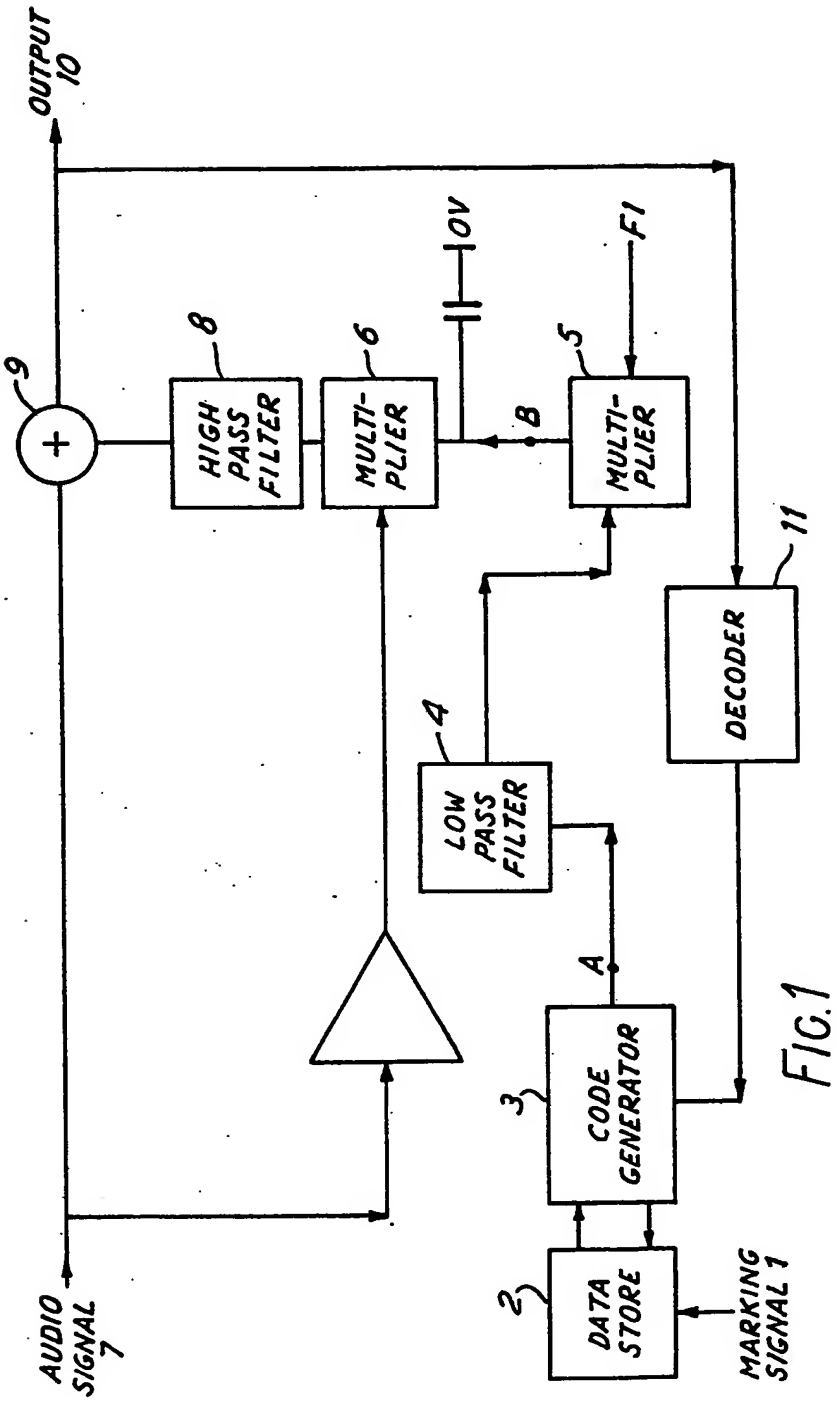


FIG.1

FIG. 2a

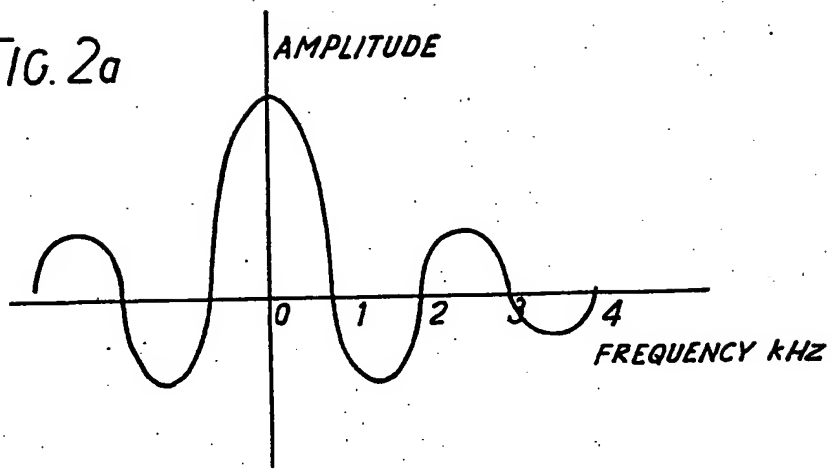
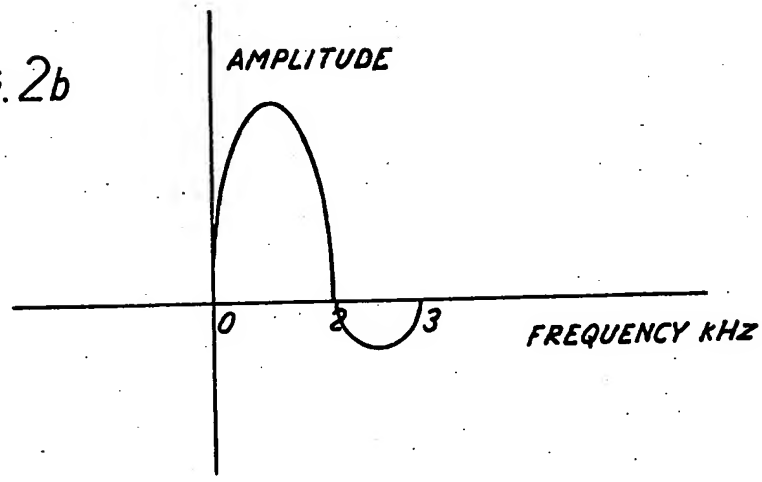

AMPLITUDE
0
1
2
3
4
FREQUENCY kHz

FIG. 2b


AMPLITUDE
0
2
3
FREQUENCY kHz

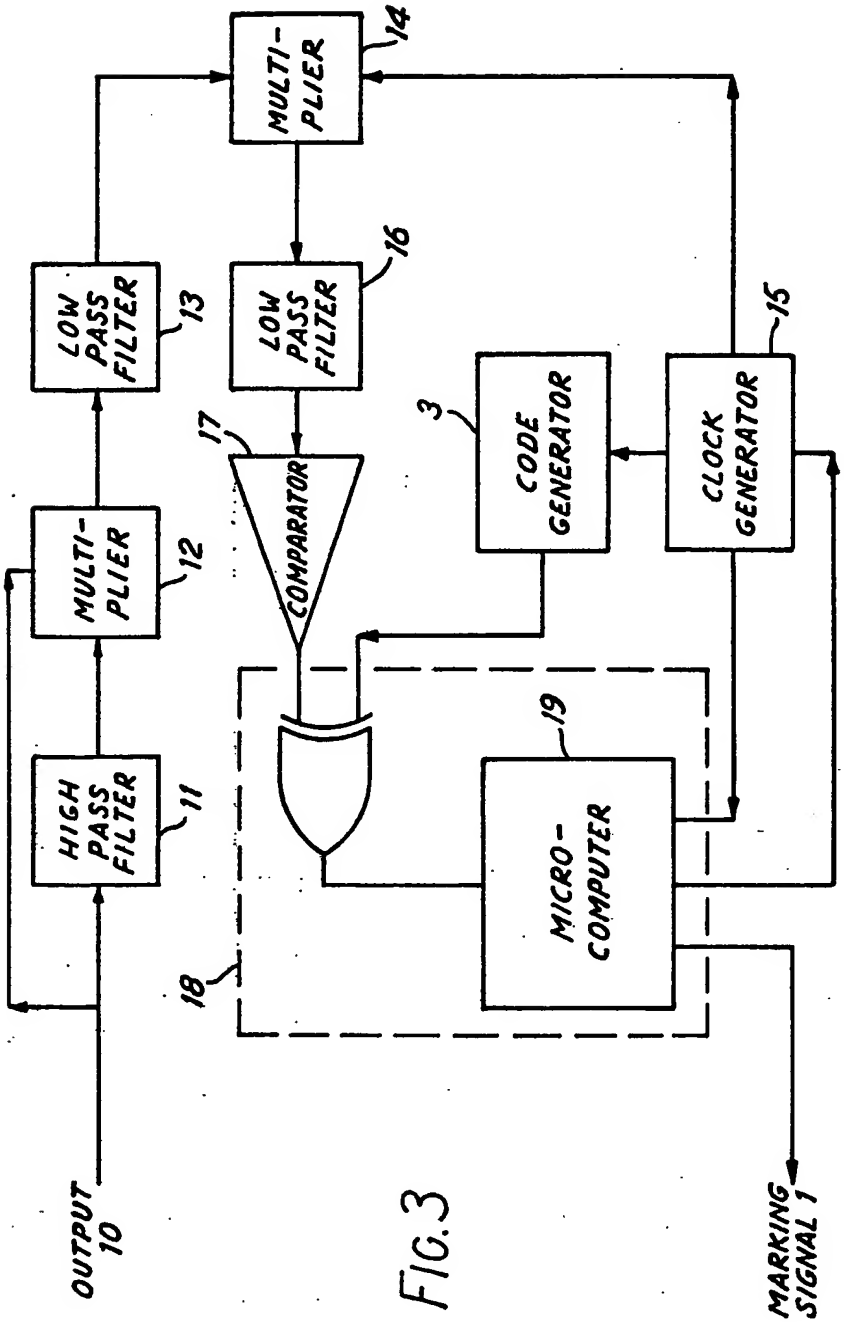

MULTI-PLIER
14
LOW PASS FILTER
13
LOW PASS FILTER
16
17
COMPARATOR
3
CODE GENERATOR
CLOCK GENERATOR
15
MULTI-PLIER
12
HIGH PASS FILTER
11
19
MICRO-COMPUTER
18
OUTPUT 10
MARKING SIGNAL 1

FIG.3

SPECIFICATION

Apparatus for marking a recorded signal

This invention relates to apparatus for marking a recorded signal and in particular, though not exclusively, for marking an audio signal being recorded on a recording medium, such as magnetic tape.

It has become important, particularly in the music recording industry, to be able to identify the source of an audio recording, especially for proving ownership of illegal re-recordings or for enabling automatic logging of play-back time of the recording for royalty purposes.

To achieve this, the recorded signal is marked by adding to the signal hidden information identifying the owner of the recording, the marking being carried out in such a way as to render the information substantially imperceptible to an ordinary listener of the recording. The spectrum, over which the added information is recorded, is made similar to that of the signal being recorded, so that it is difficult to remove, alter or destroy the added information without seriously impairing the recorded signal.

It is an object of the present invention to provide apparatus for marking a recorded signal, which apparatus provides improved protection from unauthorised detection and removal of the marking than that provided by known apparatus of this kind.

In accordance with the present invention, there is provided apparatus for marking a recorded signal, said apparatus including means for generating a marking signal comprising a sequence of binary elements and means for modulating the signal to be recorded, in accordance with said marking signal, such that said modulation is substantially imperceptible on play-back of the recorded signal, said apparatus also including means for translating each like binary element of said sequence into a randomised sequence of binary elements prior to said modulation.

The apparatus also preferably includes means for demodulating said modulated signal to produce a signal consisting of binary elements and means for correlating said signal with the randomised sequences generated by said translating means to produce said marking signal.

The present invention enables relatively low levels of the marking signal to be applied, as well as enabling the marking signal to be spread across the recorded signal in a randomised manner to produce a marking of the recorded signal, which is considerably more difficult to detect, either electronically or audibly, than marking produced by known apparatus.

The invention will now be further described by way of example only with reference to the accompanying drawings wherein:–

Figure 1 shows a block circuit diagram of a preferred embodiment of the invention,

Figures 2a and *2b* show the signal waveform at respective points in the circuit shown in Fig. 1, and

Figure 3 shows a more detailed block circuit diagram of one part of the circuit shown in Fig. 1.

In Fig. 1, a marking signal 1, indicative of an identification of the owner of a recording, comprises a sequence of binary elements, either "1" or "0", and is stored in a data store 2. The binary elements are passed to a code generator 3, which effectively translates each like binary element into a pseudorandom sequence of binary elements, to produce an encoded marking signal. Respective pseudorandom sequences are used for the two types of binary elements, such that a poor correlation between the two pseudorandom sequences is achieved. Each pseudorandom sequence typically comprises 31 binary elements and the clock rate of the binary elements is determined by an input to the code generator 3 from a clock generator (not shown in Fig. 1).

Fig. 2a shows a frequency spectrum of the output at point A in the circuit from the code generator 3, which, as shown in Fig. 2a, is a

$$\frac{\sin x}{x}$$

waveform. The clock rate from the clock generator also determines the frequency of the nulls of the waveform, i.e., as shown in Fig. 2a, the nulls are produced at 1KHz intervals, thereby indicating a clock rate of 1KHz.

The output at point A is then filtered by low pass filter 4 and converted by multiplier 5, which is also has an input F1 from the clock generator (not shown in Fig. 1), to produce an output waveform at point B in the circuit, as shown in Fig. 2b, having a frequency spectrum of 0 to 2KHz.

The encoded marking signal is then passed to multiplier 6, which also has an input of audio signal 7, which is to be recorded. The audio signal 7 is amplitude modulated, in accordance with the encoded marking signal, and the modulated signal is filtered by high pass filter 8, to remove all low frequency components of below, for example, 1KHz, and attenuated, before being added back into the audio signal channel by circuit 9, taking care to avoid distortion of the audio signal. Output signal 10, which is subsequently recorded on any suitable recording medium, such as magnetic tape, thus consists of the audio signal modulated by the encoded marking signal.

Fig. 1 also shows a decoder 11 for extracting the marking signal from the modulated audio signal to enable subsequent identification

of the owner of the recording.

The decoder 11 is shown in more detail in Fig. 3, wherein the output signal 10, from the recording, is passed through high pass filter 11 and multiplier 12, to be demodulated and rectified, and is then passed through low pass filter 13 to give the encoded marking signal. The frequency spectrum of this signal is converted down by multiplier 14, which also has an input from clock generator 15, and the output of multiplier 14 is passed through another low pass filter 16 before being digitised by comparator 17.

A correlator 18, including a microcomputer 19, then correlates the digitised signal of binary elements with the pseudorandom sequences of binary elements generated by code generator 3 to produce the marking signal 1.

The microcomputer 19 also has an input to, and output from, the clock generator 15 to enable adjustment of the clock rate.

By employing the present apparatus for maring a recorded signal, the modulation depth, i.e. the change in amplitude of the recorded signal as a result of the modulation, can be lower than 0.14, whilst still providing an acceptable data rate of the marking signal.

The marking signal may be monitored during the encoding procedure by any suitable monitoring technique. It may also be preferable to devise suitable codes, which are capable of altering the data rate according to the natural amplitude modulation of the audio signal, which then acts as noise to the encoded marking signal.

To provide an enhanced performance, an A to D convertor (not shown) may be employed, instead of the comparator 17, in decoder 11 to digitise the signal.

CLAIMS

1. Apparatus for marking a recorded signal, said apparatus including means for generating a marking signal comprising a sequence of binary elements and means for modulating the signal to be recorded, in accordance with said marking signal, such that said modulation is substantially imperceptible on play-back of the recorded signal, said apparatus also including means for translating each like binary element of said sequence into a randomised sequence of binary elements prior to said modulation.

2. Apparatus as claimed in Claim 1 and including means for demodulating said modulated signal to produce a signal consisting of binary elements and means for correlating said signal with the randomised sequences generated by said translating means to produce said marking signal.

3. Apparatus as claimed in Claim 1 or 2 wherein said translating means comprises a code generator connected to a data store for storing the marking signal.

4. Apparatus for marking a recorded signal, said apparatus being substantially as herein described with reference to the accompanying drawings.

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